

Amendments to the Claims:

The listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

- 5 1. (currently amended) A storage virtualization computer system comprising:
- a host entity for issuing IO requests;
 - an external storage virtualization controller coupled to said host entity for executing IO operations in response to said IO requests; and
 - ~~at least one~~ a group of physical storage devices (PSDs) ~~device (PSD)~~, each
- 10 coupled to the storage virtualization controller through a point-to-point serial-signal interconnect, for providing storage to the storage virtualization computer system through the storage virtualization controller;
- 15 wherein said storage virtualization controller comprises:
- a central processing circuitry for performing said IO operations in response to said IO requests of said host entity;
 - at least one IO device interconnect controller coupled to said central processing
- 20 circuitry;
- at least one host-side IO device interconnect port provided in one of said at least one IO device interconnect controller for coupling to said host entity; and
 - at least one device-side IO device interconnect port provided in one of said at least one IO device interconnect controller for coupling to ~~one of~~ said group of PSDs ~~at~~
- 25 ~~least one physical storage device~~ through said point-to-point serial-signal interconnect, said device-side IO device interconnect port being a serial port for point-to-point serial-signal transmission;
- wherein said computer system further comprises a detachable canister attached to said storage virtualization controller for containing one of said PSDs ~~at least one PSD~~
- 30 therein;

wherein said storage virtualization controller is configured to define at least one logical media unit consisting of sections of ~~at least one~~ said group of PSDs ~~PSD~~; and

5 wherein said SVC issues a device-side IO request to said IO device interconnect controller, and said IO device interconnect controller re-formats said device-side IO request and accompanying IO data into at least one data packet for transmission to said group of PSDs ~~PSD~~ through said device-side IO device interconnect port; and
10 wherein said data packet comprises a start segment at the beginning indicating the start of said data packet, an end segment at the end indicating the end of the data packet, a payload data segment containing actual IO information to transmit through the device-side IO device interconnect, and a check data segment containing check codes derived from said payload data for checking the correctness of said payload data after transmission.

15 2. (original) The storage virtualization computer system of claim 1 wherein said point-to-point serial-signal interconnect is a Serial ATA IO device interconnect.

3. (currently amended) The computer system of one of claims 1 and 2, wherein said group of PSDs ~~at least one PSD~~ comprises a SATA PSD.

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4. (currently amended) The computer system of one of claims 1 and 2, wherein said group of PSDs ~~at least one PSD~~ comprises a PATA PSD and a serial-to-parallel converter is provided between one of said device-side IO device interconnect port and said PATA PSD.

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5. (cancelled)

6. (currently amended) The computer system of one of claims 1 and 2, wherein one of said PSDs ~~at least one PSD~~ can be detached from said storage
30 virtualization controller when said storage virtualization controller is on-line.

7. (currently amended) The computer system of one of claims 1 and 2, wherein ~~said at least one~~ a new PSD can be attached to said storage virtualization controller when said storage virtualization controller is on-line.

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8. (cancelled)

9. (cancelled)

10 10. (previously presented) The storage virtualization computer system of claim 1 wherein one of said host-side IO device interconnect port and one of said device-side IO device interconnect port are provided in a same IO device interconnect controller.

15 11. (previously presented) The storage virtualization computer system of claim 1 wherein said at least one IO device interconnect controller comprises a plurality of IO device interconnect controllers; wherein one of said host-side IO device interconnect port and one of said device-side IO device interconnect port are provided in different IO device interconnect controllers.

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12. (original) The computer system of one of claims 1 and 2, wherein said storage virtualization controller comprises a plurality of host-side IO device interconnect ports each for coupling to a host-side IO device interconnect.

25 13. (original) The computer system of claim 12, wherein said storage virtualization controller is configured to present redundantly a logical media unit on at least two of said plurality of host-side IO device interconnect ports.

30 14. (previously presented) The computer system of claim 1, wherein at least one said host-side IO device interconnect port is Fibre Channel supporting

point-to-point connectivity in target mode.

15 15. (previously presented) The computer system of claim 1, wherein at least one
said host-side IO device interconnect port is Fibre Channel supporting private loop
connectivity in target mode.

10 16. (previously presented) The computer system of claim 1, wherein at least
one said host-side IO device interconnect port is Fibre Channel supporting public loop
connectivity in target mode.

17. (previously presented) The computer system of claim 1, wherein at least
one said host-side IO device interconnect port is parallel SCSI operating in target
mode.

15 18. (previously presented) The computer system of claim 1, wherein at least
one said host-side IO device interconnect port is ethernet supporting the iSCSI
protocol operating in target mode.

20 19. (previously presented) The computer system of claim 1, wherein at least
one said host-side IO device interconnect port is Serial-Attached SCSI (SAS)
operating in target mode.

25 20. (previously presented) The computer system of claim 1, wherein at least
one said host-side IO device interconnect port is Serial ATA operating in target mode.

21. (currently amended) A storage virtualization subsystem for providing
storage to a host entity, comprising:

an external storage virtualization controller for connecting to the host entity and
executing IO operations in response to IO requests issued from said host
entity; and

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~~at least one~~ a group of physical storage devices (PSDs) ~~device (PSD)~~, each coupled to the storage virtualization controller through a point-to-point serial-signal interconnect, for providing storage to the host entity through the storage virtualization controller;

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wherein said storage virtualization controller comprises:

a central processing circuitry for performing said IO operations in response to said IO requests of said host entity;

10 at least one IO device interconnect controller coupled to said central processing circuitry;

at least one host-side IO device interconnect port provided in one of said at least one IO device interconnect controller for coupling to said host entity; and

15 at least one device-side IO device interconnect port provided in one of said at least one IO device interconnect controller for coupling to said group of PSDs ~~one of said at least one physical storage device~~ through said point-to-point serial-signal interconnect, said device-side IO device interconnect port being a serial port for point-to-point serial-signal transmission;

20 wherein said subsystem further comprises a detachable canister attached to said storage virtualization controller for containing one of said PSDs ~~at least one PSD~~ therein;

25 wherein said storage virtualization controller is configured to define at least one logical media unit consisting of sections of said group of PSDs ~~at least one said PSD~~; and

wherein said SVC issues a device-side IO request to said IO device interconnect controller, and said IO device interconnect controller re-formats said device-side IO request and accompanying IO data into at least one data packet for transmission to said group of PSDs ~~PSD~~ through said device-side IO device interconnect port; and
30 wherein said data packet comprises a start segment at the beginning indicating the

5 start of said data packet, an end segment at the end indicating the end of the data
 packet, a payload data segment containing actual IO information to transmit through
 the device-side IO device interconnect, and a check data segment containing check
 codes derived from said payload data for checking the correctness of said payload data
 after transmission.

22. (original) The storage virtualization subsystem of claim 21 wherein said point-to-point serial-signal interconnect is a Serial ATA IO device interconnect.

10 23. (cancelled)

24. (previously presented) The storage virtualization subsystem of claim 21 wherein one of said host-side IO device interconnect port and one of said device-side IO device interconnect port are provided in a same IO device interconnect controller.

15 25. (previously presented) The storage virtualization subsystem of claim 21 wherein said at least one IO device interconnect controller comprises a plurality of IO device interconnect controllers; wherein one of said host-side IO device interconnect port and one of said device-side IO device interconnect port are provided
20 in different IO device interconnect controllers.

26. (currently amended) The storage virtualization subsystem of claim 21, wherein said group of PSDs ~~at least one PSD~~ comprises a SATA PSD.

25 27. (previously presented) The storage virtualization subsystem of claim 21, wherein said storage virtualization controller comprises a plurality of host-side IO device interconnect ports each for coupling to a host-side IO device interconnect.

28. (cancelled)
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29. (original) The storage virtualization subsystem of claim 27, wherein said storage virtualization controller is configured to present redundantly a logical media unit on at least two of said plurality of host-side IO device interconnect ports.

5 30. (currently amended) The storage virtualization subsystem of claim 21, wherein said group of PSDs ~~at least one PSD~~ comprises a PATA PSD and a serial-to-parallel converter is provided between one of said device-side IO device interconnect port and said PATA PSD.

10 31. (cancelled)

32. (currently amended) The storage virtualization subsystem of claim 21, wherein one of said PSDs ~~at least one PSD~~ can be detached from said storage virtualization controller when said storage virtualization controller is on-line.

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33. (currently amended) The storage virtualization subsystem of claim 21, wherein said ~~at least one~~ a new PSD can be attached to said storage virtualization controller when said storage virtualization controller is on-line.

20 34. (currently amended) The storage virtualization subsystem of claim 21, wherein said group of PSDs include a first set of PSDs and a second set of PSDs, said first set of PSDs and said second set of PSDs are not received in a same enclosure, and said storage virtualization controller further comprises at least one multiple-device device-side expansion port for ~~accommodating an additional~~ coupling to said second
25 set of said PSDs ~~at least one PSD~~.

35. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is Fibre Channel supporting point-to-point connectivity in target mode.

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36. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is Fibre Channel supporting private loop connectivity in target mode.

5 37. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is Fibre Channel supporting public loop connectivity in target mode.

10 38. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is parallel SCSI operating in target mode.

15 39. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is ethernet supporting the iSCSI protocol operating in target mode.

20 40. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is Serial-Attached SCSI (SAS) operating in target mode.

41. (previously presented) The storage virtualization subsystem of claim 21, wherein at least one said host-side IO device interconnect port is Serial ATA operating in target mode.

25 42. (previously presented) The storage virtualization subsystem of claim 21 further comprising an enclosure management services mechanism.

30 43. (original) The storage virtualization subsystem of claim 42, wherein said enclosure management services mechanism manages and monitors at least one of the following devices belonging to the storage virtualization subsystem: power supplies,

fans, temperature sensors, voltages, uninterruptible power supplies, batteries, LEDs, audible alarms, PSD canister locks, door locks.

44. (original) The storage virtualization subsystem of claim 42, wherein said
5 enclosure management services mechanism is configured to support direct-connect EMS configuration.

45. (original) The storage virtualization subsystem of claim 42, wherein said
enclosure management services mechanism is configured to support device-forwarded
10 EMS configuration.

46. (original) The storage virtualization subsystem of claim 42, wherein said
enclosure management services mechanism is configured to support direct-connect
EMS configuration and device-forwarded EMS configuration.
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47. (original) The storage virtualization subsystem of claim 42, wherein said
enclosure management services mechanism is configured to support SES enclosure
management services protocol.

20 48. (original) The storage virtualization subsystem of claim 42, wherein said
enclosure management services mechanism is configured to support SAF-TE
enclosure management services protocol.

49. (original) The storage virtualization subsystem of claim 42, wherein said
25 EMS mechanism further comprises I2C latches to communicate with said storage
virtualization controller.

50. (original) The storage virtualization subsystem of claim 42, wherein said
EMS mechanism further comprises status-monitoring circuitry to communicate with
30 said storage virtualization controller.

51. (original) The storage virtualization subsystem of claim 42, wherein said EMS mechanism further comprises the following mechanism to communicate with said storage virtualization controller: I2C latches and status-monitoring circuitry.

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52. (original) The storage virtualization subsystem of claim 42, wherein said EMS mechanism further comprises a CPU for running a program.

53. (original) The storage virtualization subsystem of claim 42, wherein said
10 EMS mechanism further comprises at least one I2C interconnect as a primary communication media to said storage virtualization controller.

54. (withdrawn) An external storage virtualization controller for executing IO operations in response to IO requests from a host entity, comprising:
15 a central processing circuitry for performing IO operations in response to said IO requests of said host entity;
at least one IO device interconnect controller coupled to said central processing circuitry;
at least one host-side IO device interconnect port provided in a said at least one
20 IO device interconnect controller for coupling to said host entity; and
at least one device-side IO device interconnect port provided in a said at least one IO device interconnect controller for coupling to and performing point-to-point serial-signal transmission with at least one physical storage device.

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55. (withdrawn) The external storage virtualization controller of claim 54 wherein said device-side IO device interconnect controller comprises at least one Serial ATA port, each for connecting to a said at least one physical storage device through a Serial ATA IO device interconnect.

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56. (withdrawn) The external storage virtualization controller of one of claims 54 and 55 wherein a said host-side IO device interconnect port and a said device-side IO device interconnect port are provided in the same IO device interconnect controller.

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57. (withdrawn) The external storage virtualization controller of one of claims 54 and 55 wherein a said host-side IO device interconnect port and a said device-side IO device interconnect port are provided in different IO device interconnect controllers.

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58. (withdrawn) The external storage virtualization controller of one of claims 54 and 55 wherein said device-side IO device interconnect controller further comprises a PCI/PCI-X interface for connecting to the central processing circuit.

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59. (withdrawn) The external storage virtualization controller of one of claims 54 and 55 wherein said device-side IO device interconnect controller further comprises a PCI Express interface for connecting to the central processing circuit.

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60. (withdrawn) The external storage virtualization controller of one of claims 54 and 55, wherein said storage virtualization controller comprises a plurality of host-side IO device interconnect ports each for coupling to a host-side IO device interconnect.

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61. (withdrawn) The external storage virtualization controller of one of claims 54 and 55, wherein said storage virtualization controller is configured for defining at least one logical media unit consisting of sections of said at least one PSD.

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62. (withdrawn) The external storage virtualization controller of claim 60, wherein said storage virtualization controller is configured for presenting redundantly

a logical media unit on at least two of said plurality of host-side IO device interconnect ports.

63. (withdrawn) The external storage virtualization controller of one of claims
5 54 and 55, wherein at least one said PSD is a direct-access storage device (DASD) and
said storage virtualization controller is configured for defining a logical media unit
consisting of sections of at least one said direct access storage device and said logical
media unit is of RAID level or a combination of RAID levels, whereby said logical
media unit is contiguously addressable by said host entity.

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64. (withdrawn) The external storage virtualization controller of one of claims
54 and 55 further comprising at least one multiple-device device-side expansion port
for accommodating a second set of at least one PSD.

15 65. (withdrawn) The external storage virtualization controller of one of claims
54 and 55, wherein at least one said host-side IO device interconnect port is Fibre
Channel supporting point-to-point connectivity in target mode.

20 66. (withdrawn) The external storage virtualization controller of one of claims
54 and 55, wherein at least one said host-side IO device interconnect port is Fibre
Channel supporting private loop connectivity in target mode.

25 67. (withdrawn) The external storage virtualization controller of one of claims
54 and 55, wherein at least one said host-side IO device interconnect port is Fibre
Channel supporting public loop connectivity in target mode.

68. (withdrawn) The external storage virtualization controller of one of claims
54 and 55, wherein at least one said host-side IO device interconnect port is parallel
SCSI operating in target mode.

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69. (withdrawn) The external storage virtualization controller of one of claims 54 and 55, wherein at least one said host-side IO device interconnect port is ethernet supporting the iSCSI protocol operating in target mode.

5 70. (withdrawn) The external storage virtualization controller of one of claims 54 and 55, wherein at least one said host-side IO device interconnect port is Serial-Attached SCSI (SAS) operating in target mode.

10 71. (withdrawn) The external storage virtualization controller of one of claims 54 and 55, wherein at least one said host-side IO device interconnect port is Serial ATA operating in target mode.

15 72. (withdrawn) The external storage virtualization controller of one of claims 54 and 55 further comprising an enclosure management services mechanism.

73. (withdrawn) The storage virtualization controller of claim 72, wherein said enclosure management services mechanism is configured to support direct-connect EMS configuration.

20 74. (withdrawn) The storage virtualization controller of claim 72, wherein said enclosure management services mechanism is configured to support device-forwarded EMS configuration.

25 75. (withdrawn) The storage virtualization controller of claim 72, wherein said enclosure management services mechanism is configured to support direct-connect EMS configuration and device-forwarded EMS configuration.

30 76. (withdrawn) The storage virtualization controller of claim 72, wherein said storage virtualization controller is configured to support SES enclosure management services protocol.

77. (withdrawn) The storage virtualization controller of claim 72, wherein said storage virtualization controller is configured to support SAF-TE enclosure management services protocol.

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78. (currently amended) A method for performing storage virtualization in a computer system with an external storage virtualization controller of the computer system, the method comprising:

receiving, by the storage virtualization controller, an IO request from a host
10 entity of the computer system ~~with the storage virtualization controller~~;
parsing, by the storage virtualization controller, the IO request ~~with the storage~~
~~virtualization controller~~ to decide at least one IO operation to perform in
response to said IO request;
performing, by the storage virtualization controller, at least one IO operation
15 ~~with the storage virtualization controller~~ to access a group of at least one
physical storage devices (PSDs) ~~device (PSD)~~ of the computer system in
point-to-point serial-signal transmission; and
performing said at least one IO operation by a central processing circuitry in the
storage virtualization controller in response to said IO request of said host
20 entity;

wherein said storage virtualization controller includes:

at least one IO device interconnect controller coupled to said central processing
25 circuitry;
at least one host-side IO device interconnect port provided in one of said at least
one IO device interconnect controller for coupling to said host entity; and
at least one device-side IO device interconnect port provided in one of said at least
one IO device interconnect controller for coupling to said group of PSDs ~~one of~~
30 ~~said at least one physical storage device~~ through said point-to-point serial-signal

interconnect, said device-side IO device interconnect port being a serial port for point-to-point serial-signal transmission;

wherein said computer system further comprises a detachable canister attached to said storage virtualization controller for containing one of said PSDs ~~at least one PSD~~

5 therein;

wherein said storage virtualization controller is configured to define at least one logical media unit consisting of sections of said group of PSDs ~~at least one said PSD~~; and

wherein said SVC issues a device-side IO request to said IO device interconnect

10 controller, and said IO device interconnect controller re-formats said device-side IO request and accompanying IO data into at least one data packet for transmission to said group of PSDs ~~PSD~~ through said device-side IO device interconnect port; and

wherein said data packet comprises a start segment at the beginning indicating the start of said data packet, an end segment at the end indicating the end of the data

15 packet, a payload data segment containing actual IO information to transmit through the device-side IO device interconnect, and a check data segment containing check codes derived from said payload data for checking the correctness of said payload data after transmission.

20 79. (original) The method of claim 78 wherein the point-to-point serial-signal transmission is performed in a format complying with a Serial ATA protocol.

80. (original) The method of one of claims 78 and 79 further comprising the step of providing an enclosure management services mechanism.

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81. (original) The method of claim 80 further comprising the step of executing said enclosure management services mechanism when said mechanism is configured to support direct-connect EMS configuration.

30 82. (original) The method of claim 80 further comprising the step of executing

said enclosure management services mechanism when said mechanism is configured to support device-forwarded EMS configuration.

5 83. (original) The method of claim 80 further comprising the step of executing said enclosure management services mechanism when said mechanism is configured to support direct-connect EMS configuration and device-forwarded EMS configuration.

10 84. (original) The method of claim 80 further comprising the step of executing said enclosure management services mechanism when said storage virtualization controller is configured to support SES enclosure management services protocol.

15 85. (original) The method of claim 80, further comprising the step of executing said enclosure management services mechanism when said storage virtualization controller is configured to support SAF-TE enclosure management services protocol.

 86. (currently amended) The method of one of claims 78 and 79, wherein said group of PSDs ~~at least one PSD~~ comprises a SATA PSD.

20 87. (currently amended) The method of one of claims 78 and 79, wherein group of PSDs ~~at least one PSD~~ comprises a PATA PSD and serial signals in said serial signal transmission are converted by a serial-to-parallel converter to parallel signals compliant with said PATA PSD.

25 88. (cancelled)

 89. (cancelled)

30 90. (currently amended) A computer-readable storage medium having a computer program code stored therein that is capable of causing a computer system

having an external storage virtualization controller and a group of ~~at least one~~ physical storage devices (PSDs) ~~device~~ connected to the storage virtualization controller to perform the steps of:

- 5 receiving, by the storage virtualization controller, an IO request from a host entity of the computer system ~~with the storage virtualization controller~~;
- parsing, by the storage virtualization controller, the IO request ~~with the storage virtualization controller~~ to decide at least one IO operation to perform in response to said IO request;
- 10 performing said at least one IO operation with the storage virtualization controller to access said group of PSDs ~~at least one physical storage device (PSD)~~ in point-to-point serial-signal transmission; and
- performing said at least one IO operation by a central processing circuitry in the storage virtualization controller in response to said IO request of said host entity;

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wherein said storage virtualization controller includes:

- at least one IO device interconnect controller coupled to said central processing circuitry;
- 20 at least one host-side IO device interconnect port provided in one of said at least one IO device interconnect controller for coupling to said host entity; and
- at least one device-side IO device interconnect port provided in one of said at least one IO device interconnect controller for coupling to one of said PSDs ~~at least one physical storage device~~ through said point-to-point
- 25 serial-signal interconnect, said device-side IO device interconnect port being a serial port for point-to-point serial-signal transmission;

wherein said computer system further comprises a detachable canister attached to said storage virtualization controller for containing one of said PSDs ~~at least one PSD~~ therein;

- 30 wherein said storage virtualization controller is configured to define at least one

logical media unit consisting of sections of said group of PSDs ~~at least one said PSD~~; and

wherein said SVC issues a device-side IO request to said IO device interconnect controller, and said IO device interconnect controller re-formats said device-side IO request and accompanying IO data into at least one data packet for transmission to said group of PSDs ~~PSD~~ through said device-side IO device interconnect port; and

wherein said data packet comprises a start segment at the beginning indicating the start of said data packet, an end segment at the end indicating the end of the data packet, a payload data segment containing actual IO information to transmit through the device-side IO device interconnect, and a check data segment containing check codes derived from said payload data for checking the correctness of said payload data after transmission.

91. (original) The computer-readable storage medium of claim 90 wherein the point-to-point serial-signal transmission is performed in a format complying with a Serial ATA protocol.

92. (currently amended) The computer-readable storage medium of one of claims 90 and 91, wherein said group of PSDs ~~at least one PSD~~ comprises a SATA PSD.

93. (currently amended) The computer-readable storage medium of one of claims 90 and 91, wherein said group of PSDs ~~at least one PSD~~ comprises a PATA PSD and serial signals in said serial signal transmission are converted by a serial-to-parallel converter to parallel signals compliant with said PATA PSD.

94. (cancelled)

95. (cancelled)

96. (cancelled)

97. (new) The storage virtualization computer system of claim 1, wherein said group of PSDs are received in a plurality of enclosures.

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98. (new) The storage virtualization subsystem of claim 21, wherein said group of PSDs are received in a plurality of enclosures.

99. (new) The method of claim 78, wherein said group of PSDs are received in a plurality of enclosures.

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100. (new) The computer-readable storage medium of claim 90, wherein said group of PSDs are received in a plurality of enclosures.

101. (new) The storage virtualization computer system of claim 1, wherein said group of PSDs include a first set of PSDs and a second set of PSDs, said first set of PSDs and said second set of PSDs are not received in a same enclosure, and said storage virtualization controller further comprises at least one multiple-device device-side expansion port for coupling to said second set of said PSDs.

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102. (new) The method of claim 78, wherein said group of PSDs include a first set of PSDs and a second set of PSDs, said first set of PSDs and said second set of PSDs are not received in a same enclosure, and said storage virtualization controller further comprises at least one multiple-device device-side expansion port for coupling to said second set of said PSDs.

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103. (new) The computer-readable storage medium of claim 90, wherein said group of PSDs include a first set of PSDs and a second set of PSDs, said first set of PSDs and said second set of PSDs are not received in a same enclosure, and said storage virtualization controller further comprises at least one multiple-device

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device-side expansion port for coupling to said second set of said PSDs.